ORIBATID MITES IN A FOREST SOIL ECOSYSTEM

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ПАНЦИРНЫЕ КЛЕЩИ В ЭКОСИСТЕМЕ ЛЕСНОЙ ПОЧВЫ

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Introduction

Several studies have been concerned with the abundance, distribution and other ecological aspects of oribatid mites /3,2/. Study on the oribatid mites in a forest soil ecosystem has been made in north-west Switzerland during 1979-1980.It was concerned with the dispersion, abundance, population dynamics and the role of this group in the soil system /4/.

Based on this investigation the present paper reports on some selected aspects of the results such as abundance, distribution, diversity, community structure and population dynamics. The aim is to give an overview and a synthesis of these aspects and to discuss the role of oribatids in the functioning of the soil ecosystem.

Site Description

The study site is situated in a Querco-carpinetum association with planted pine trees.

The sampling site contained three tree species characteristic of the forest, i.e. Quercus robur, Fagus silvatica and Pinus silvestris standing in a triangle of about 12 m sidelength.

The soil is a well-drained brown earth on loess with a small-scale mosaic of mull and moder humus and a pH ranging from 3.8 to 5.2. Organic matter content varied from 5.0% around Quercus to 5.7% around Fagus (Pinus: 5.2%). The annual rainfall during the year of sampling was 842 mm with its maxima in June and August. Temperature in the litter layer ranged from 1.8°C in February to 19.8°C in August, whereas it ranged from 3.5 to 19.8°C in the soil (5 cm depth) in the same months. Soil moisture content was measured from 17.2% in October to 28.4% (% of wet weight) in February.

Methods

Samples of about 130 cm^3 were taken with a soil corer to a depth of 5 cm, sometimes also to a depth of 20 cm. Equally spaced samples were taken in concentric circles around each of the three trees. At a distance of 30 cm eight samples were taken each month from each tree from February 1979 to February 1980. On the same radii at three-monthly intervals, samples were taken at distances of 10, 50, and 70 cm. Samples were also collected at three-monthly intervals on straight lines between the three trees and eight samples at 30 cm distance from the trees to a depth of 20 cm, divided into four subsamples of 5 cm. The soil arthropods were extracted in a modified high-gradient Macfadyen extractor.

Results

Species composition and diversity. A total of 65 oribatid species was recorded. They exhibited an irregular species distribution and species composition over the site. Around Quercus a total of 38 species (59% of the total) was found, around Fagus 42 species (65%) of the total were present and around Pinus 44 species (68%). A total of 22 species (34%) occurred around all three trees whereas some species were confined to one tree, i.e. 5 species (8%) to Quercus, 8 species (12%) to Fagus and 11 species (17%) to Pinus. A total of 6 species (9%) occurred around Quercus and Fagus, 6 species around Fagus and Pinus, and 5 species (8%) around Quercus and Pinus. On the transects 40 species (62%) were recorded.

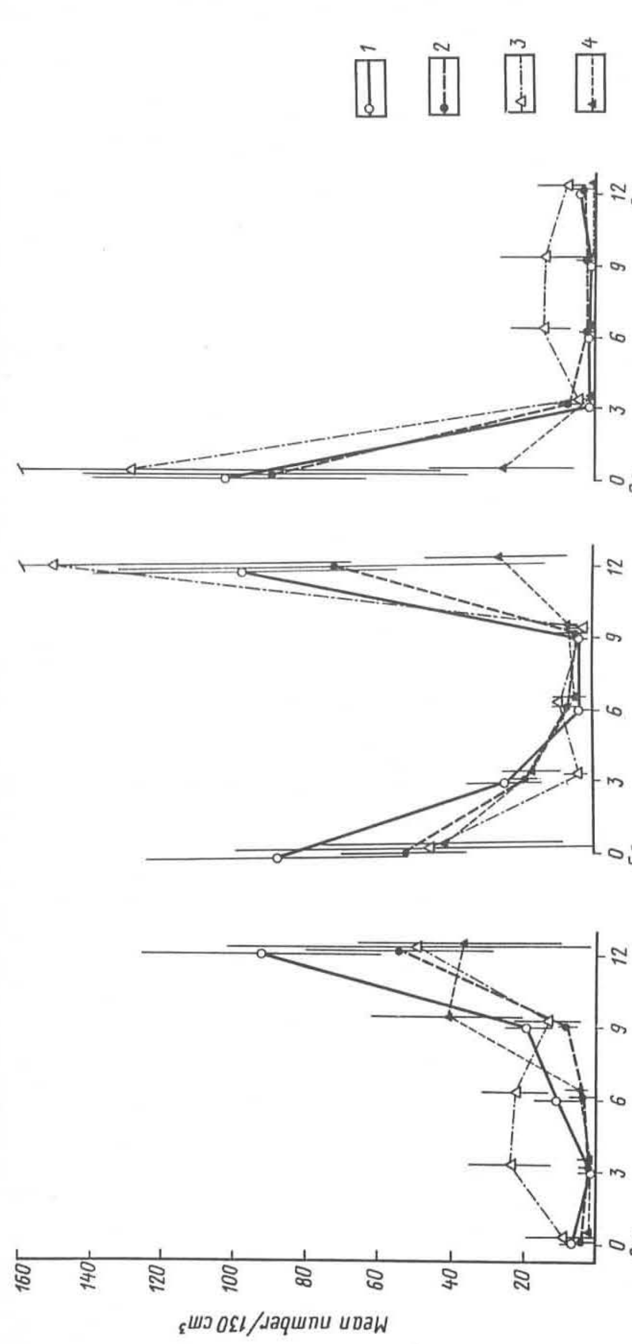
The mean annual diversity (Shannon-Wiener index: H) from samples taken at 30 cm distance from the trees was 2.4 (H_{max} = 4.4, Eveness E = 0.5) around Quercus. Around Fagus H was 3.2 (H_{max} = 7.9, E = 0.4). Pinus showed the lowest diversity with H = 2.0 (H_{max} = 7.9, E = 0.3). Species number and diversity declined sharply from the 0-5 cm depth soil layer to the three deeper layers (5-10, 10-15 and 15-20 cm).

Abundance and distribution patterns. Fig. 1 shows the abundance and the typical distribution pattern of all the oribatids over the site and this did not change significantly throughout the year. Abundance was lowest around Quercus and highest around Pinus, where a single species, Tectocepheus velatus accounted for 67% of all individuals. Abundance on the transects was generally low with a sharp increase close to the tree bases.

The average density around Quercus was 1619 ind m^{-2}, aroung Fagus 25432 ind m^{-2} and around Pinus it was 34679 ind m^{-2}.

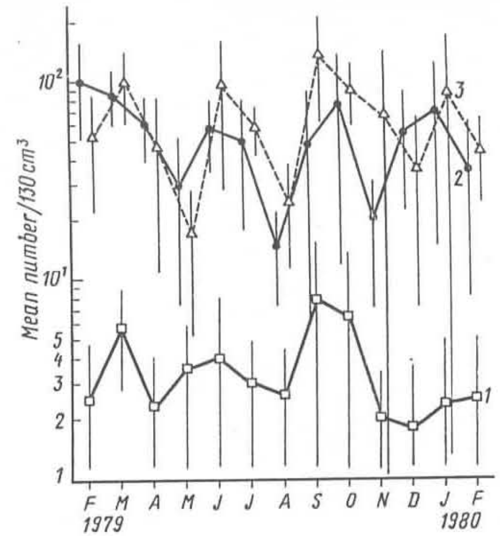
The mean density decreased sharply close to the trees, i.e. from 10 to 70 cm. This pattern based on mean densities however, was underlain by a more complex small-scale pattern /5/.

Community structure. According to the abundance and distribution of oribatids over the site, various characteristic mite communities were described.

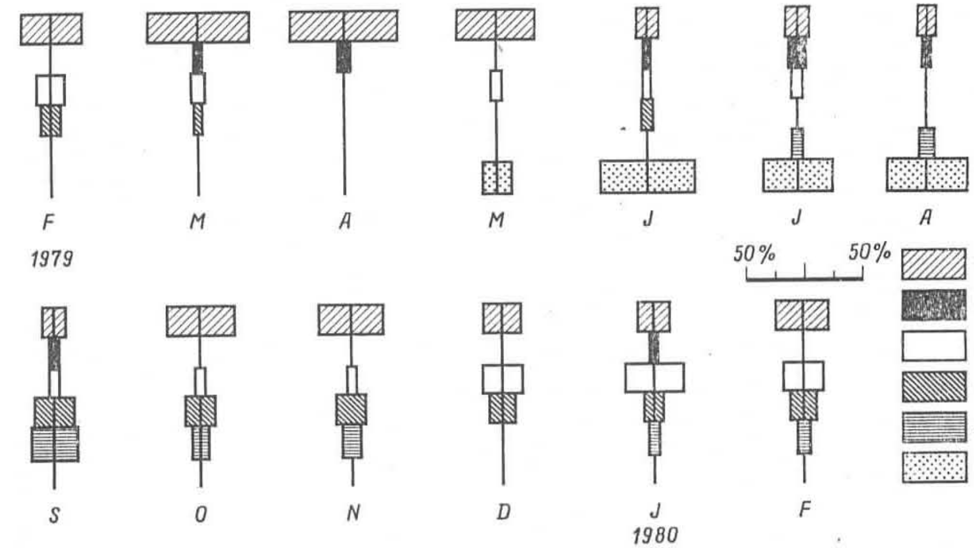


F i g. 1. Mean (± SD) number of oribatid mites on transects between trees (abscisse) and at different seasons: 1 - March; 2 - June; 3 - September; 4 - December. Distance in meters. Positions near the trees in 30 cm distance from the base

Q.r. - Quercus robur; F.s. - Fagus sylvatica; P.s. - Pinus silvestris



F i g. 2. Abundance of oribatid mites near Quercus robur (1), Fagus sylvatica (2) and Pinus silvestris (3) at the study site



F i g. 3. Age class distribution in percentage of Platynothrus peltifer during the study period. Age classes: 1 - adults; 2 - tritonymphs; 3 - deutonymphs; 4 - protonymphs; 5 - larvae; 6 - eggs

Associations of species were evident around Quercus. In a sample series which contained 15 species, 5 were significantly associated at a 1% level and 7 on a 5% level. In a series around Fagus with 23 species, 8 were associated on a 1% level and 14 on a 5% level. Three of the most abundant species, Oppia obsoleta, Suctobelba subtrigona and Tectocepheus velatus were also closely as-

sociated. Tectocepheus velatus, the dominant species around Pinus was associated on a 5% level with two of the 19 species found in the series there. Only two pairs were associated on a 1% level, whereas 11 other species were associated at a 5% level.

Population dynamics. The seasonal dynamics (Fig.2)showed peaks in spring (March-April) and autumn (September-October). A detailed analysis was only possible for four species. Platynothrus peltifer, Tectocepheus velatus, Oribatula tibialis and Scheloribates pallidulus were extracted in sufficient numbers and their live stages could be found and identified. They all showed relatively large seasonal fluctuations in numbers, which may be explained by the high net reproductivity rate R_0 of between 6.0 and 9.5 in relation to the environmental conditions. The age class distribution also showed annual patterns, e.g. Platynothrus peltifer had one generation per year (Fig. 3).

Biomass. According to the distribution patterns and seasonal fluctuations, oribatid biomass also varied in space and time. However, because of the changing proportion of large species in the total, the biomass pattern may differ from the distribution of the individuals. Thus, the individuals found around Quercus made up 6.4% and 4.7% of those found around Fagus and Pinus respectively. In contrast the proportion of the biomass around Quercus was 40% and 27% of that around Fagus and Pinus, respectively. The mean annual biomass(live weight) was 63 mg m^{-2} around Quercus, 159 mg m^{-2} around Fagus and 231 mg m^{-2} around Pinus.

Discussion

The oribatid mites found in this study showed a distinct small-scale distribution pattern in relation to the tree species. A non-paramatric correlation analysis /4/ between individual samples from the same micro-site for mite showed a significant correlation only between total oribatid distribution and organic matter content (Kendall Rank Correlation Coefficient 0.2216; Spearman Rank Correlation Coefficient 0.3004; $p < 0.025$). No other factor was significantly correlated with oribatid population density, but several factors correlated with single species density, e.g. soil moisture with Platynothrus peltifer, Oppia nova and Tectocepheus velatus population density.

Species distribution and their seasonal fluctuations reflected communities which did not change significantly throughout the study year. However, it was not possible to detect the centres or boundaries of these communities in detail. This shows also that soil animals are not organized into well-defined communities /1/. However, oribatid mite aggregations and communities may be correlated to micro-habitat structure and micro-climate, but on a level which usually is not recorded in environmental measurements.

Regarding biomass, the oribatid mites in the soil ecosystem play a minor role in total soil metabolism and as a nutrient store. As regulators of fungal populations, however, they are of considerable importance for the functioning of the soil system.

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TARSONEMUS FUSARII COOREMAN 1941 AND TARSONEMUS PARAFUSARII KALISZEWSKI 1983 (ACARI: HETEROSTIGMATA) IN POLAND

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TARSONEMUS FUSARII COOREMAN, 1941 И TARSONEMUS PARAFUSARII KALISZEWSKI, 1983 (ACARI: HETEROSTIGMATA) В ПОЛЬШЕ

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The authors have undertaken an attempt to characterize two species of Tarsonemidae family: Tarsonemus fusarii and Tarsonemus parafusarii.

T.fusarii belongs to the most frequently encountered representatives of this family. It has been described on the basis of specimens found in fungi culture of Fusarium sp./2/. In Central Europe it was found usually in cultures of Fusarium sp., Altenaria tenuis Nees, Botrytis cinerea Persoon et Fries, Cerospora coffeicola Berkeley, in the mould of oak and linden, in hornet nest /12,1/, in Japan - on wilting grasses and decaying pear tree leaves /3/, in Canada - on Fomes fomentarius /9/ and in corn elevators /7/, in the U.S.A. - under the bark of trees infected by bark beetles /10/, in Denmark - in allergic dust /6/, and in USSR - in Crimea /8/. The wide expansion of this species is connected with its high dispersion possibilities favoured by its small body size facilitating the transfer of these animals by wind /11/, as well as a high fertility, short life cycle and the possibility to feed on different fungi species /13/.

Tarsonemus parafusarii has been described on the basis of specimens found in the mould of Alnus incana L. in Poland /5/. Among the known species of Tarsonemidae it is morphologically most similar to Tarsonemus fusarii.

In order to make an ecological analysis of both species, 662 samples were inspected from the collection of the A.Mickiewicz University in Poznan /5/.